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of superheated steam taken at different intervals of temperature from the maximum temperature of saturation.

Number of the Exper.	Max. temp. of saturation.	Temperatures between which the expansion is taken.		Coefficient of expansion of superheated steam.	Coefficient of expansion of air.
1	136°77	140	170	$\frac{1}{353}$	$\frac{1}{359}$
2	155°33	160	190	$\frac{1}{336}$	$\frac{1}{319}$
3	159°36	159°36	170°2	$\frac{1}{120}$	$\frac{1}{618}$
		170°2	209°9	$\frac{1}{624}$	$\frac{1}{629}$
5	171°48	171°48	180	$\frac{1}{200}$	$\frac{1}{630}$
		180	200	$\frac{1}{604}$	$\frac{1}{639}$
6	174°92	174°92	180	$\frac{1}{100}$	$\frac{1}{634}$
		180	200	$\frac{1}{637}$	$\frac{1}{639}$
7	182°30	182°3	186	$\frac{1}{230}$	$\frac{1}{641}$
		186	209°5	$\frac{1}{630}$	$\frac{1}{645}$
8	188°30	191	211	$\frac{1}{604}$	$\frac{1}{650}$
1'	242°9	243	249	$\frac{1}{517}$	$\frac{1}{702}$
4'	255°5	257	259	$\frac{1}{392}$	$\frac{1}{716}$
		257	264	$\frac{1}{600}$	$\frac{1}{716}$
6'	267°21	268	271	$\frac{1}{210}$	$\frac{1}{727}$
		271	279	$\frac{1}{640}$	$\frac{1}{730}$
7'	269°2	271	273	$\frac{1}{232}$	$\frac{1}{730}$
		273	279	$\frac{1}{531}$	$\frac{1}{733}$
9'	279°42	283	285	$\frac{1}{298}$	$\frac{1}{742}$
		285	289	$\frac{1}{533}$	$\frac{1}{744}$
13'	292°53	297	299	$\frac{1}{241}$	$\frac{1}{753}$
		299	302	$\frac{1}{638}$	$\frac{1}{758}$

Hence it appears, that as the steam becomes more and more superheated, the coefficient of expansion approaches that of a perfect gas. The authors hope that these experiments may be continued, and that the results obtained at greatly increased pressures will prove as important as those already arrived at.

May 24, 1860.

Sir BENJAMIN C. BRODIE, Bart., President, in the Chair.

In accordance with Notice given at the last Meeting, the Right Hon. Earl de Grey and Ripon was proposed for election and immediate ballot; and the ballot having been taken, his Lordship was declared duly elected.

Alexander Dallas Bache, Hermann Helmholtz, Albert Kölliker, and Philippe Edouard Poullotier de Verneuil were severally balloted for, and declared duly elected Foreign Members of the Society.

The following communications were read :—

- I. "On a new Method of Approximation applicable to Elliptic and Ultra-elliptic Functions." By C. W. MERRIFIELD, Esq.
Communicated by the Rev. H. MOSELEY, F.R.S. Received
March 26, 1860.

(Abstract.)

I found my method on the known principle, that the geometric mean between two quantities is also a geometric mean between the arithmetic and harmonic means of those quantities.

We may therefore approximate to the geometric mean of two quantities in this way :—Take their arithmetic and harmonic means ; then take the arithmetic and harmonic means of those means ; then of these last means again, and so on, as far as we please. If the ratio of the original quantities lies within the ratio of 1 : 2, the approximation proceeds with extraordinary rapidity, so that, in obtaining a fraction nearly equal to $\sqrt{2}$ by this method, we obtain a result true to eleven places of decimals at the fourth mean. I name this merely to show the rate of approximation. The real application of the method is to the integration of functions embracing a radical of the square root.

Suppose we wish to approximate to the integral of a function of the form $X\sqrt{Y}$. The function is a geometrical mean between X and XY . If, therefore, we obtain arithmetic and harmonic means to X and XY , and again to these means, and so on, it is clear that our function $X\sqrt{Y}$ will always lie between each pair of means of the series, the arithmetic mean being always in excess, and the harmonic always in defect. I now observe,—

(1) That if the functions X and XY both increase or both decrease regularly with the independent variable, the integral of their geometric mean will always be intermediate to their integrals, and also to each pair of the integrals of the derived means.

(2) That the derived series of arithmetic and harmonic means contain no radicals, and are therefore integrable by resolution into partial fractions, and that their integrals involve only logarithms or inverse tangents.

The last remark indicates that the method has no useful application to functions of a simpler class than elliptic functions. It applies, however, to all elliptic and ultra-elliptic functions, and to transcend-

ental functions under a radical. The radical must, however, not be higher than the square root ; for, although it be true that if we take the case of inserting two means between two quantities, the geometric will still lie between the arithmetic and harmonic means, we have nothing to show what the second step of approximation is to be.

The third arithmetic mean is, in the case of elliptic integrals, sufficiently near for working with seven figures. The resulting formula, in the case of the elliptic integral of the third kind, is far from being simple ; but it is practicable, and it requires none but the ordinary trigonometric and logarithmic tables. This complexity is in reality due to the extremely complex character of the function itself, as is well known to every one conversant with its transformations. My method becomes sufficiently simple when applied to complete elliptic functions of the first kind.

My own opinion is that this method affords as easy an approximation as the nature of the elliptic and ultra-elliptic integrals, at least in their general form, admits,—that it is simpler than the use of Jacobi's functions Θ or Υ , and that except in isolated cases, there is no advantage to be derived from the computation of tables of such auxiliary functions, so far as the mere computation of elliptic functions is concerned.

II. "On the Lunar Diurnal Variation of Magnetic Declination at the Magnetic Equator." By JOHN ALLAN BROWN, F.R.S., Director of the Trevandrum Observatory. Received March 28, 1860.

This variation, first obtained by M. Kreil, next by myself, and afterwards by General Sabine, presents several anomalies which require careful consideration, and especially a careful examination of the methods employed to obtain the results. The law obtained seems to vary from place to place even in the same hemisphere and in the same latitude, and this to such an extent, that, for example, when the moon is on the inferior meridian at Toronto it produces a minimum of westerly declination ; while for the moon on the inferior meridian of Prague and Makerstoun in Scotland it produces a maximum of westerly declination. No two places have as yet given exactly the